

Three Dimensional Knowledge Visualization in the Theatre Studies Classroom

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ABSTRACT

Education is naturally a social process, where knowledge is an experience and information is an environment. Cyberspace is able to create a new multi-participant classroom, where learners are able to compare various forms of delivery and choose one they prefer. Computer-mediated learning can greatly shift traditional modes of knowledge delivery towards a more visually-enhanced experience, which is especially important for exploring scenographic artefacts. New approaches to theatre education and research have already been established through the global use of digital communication technologies. Three dimensional (3D) modelling and navigation techniques proved very efficient in improving the understanding of communicative qualities of set design and accelerating learning. In this paper, I will introduce the first 3D reconstruction of one of the finest examples of unrealized modernist stage design – *The Divine Comedy* (1921) by Norman Bel Geddes. The model is integrated within the body of the Set-SPECTRUM educational project, which was created with the intention to enable theatre students and scholars to understand and study this remarkable stage-construction using digital means of presentation. This approach to knowledge visualization aims to strengthen the established approach to research, learning, and teaching, but also to transform the passive consumers of digital products into active participants. The paper concludes with a detailed discussion of the social implications of using computer-generated learning environments.

Categories and Subject Descriptors

A.0 [General Literature]: General – *conference proceedings*;
H.3.m [Information Storage and Retrieval]: Miscellaneous;
H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems – *artificial, augmented and virtual realities*;
J.5 [Computer Applications]: Arts and Humanities – *performing arts*; K.3.1 [Computing Milieux]: Computers and Education – *computer uses in education*.

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General Terms

Performance, Design, Theory.

Keywords

Bel Geddes, Edutainment, Knowledge Visualization, Set Design, Set-SPECTRUM, Theatre History, 3-D Reconstruction.

1. INTRODUCTION

In recent years, novel modes to spread knowledge have been created, resulting in a world-wide and rapid distribution of ideological, cultural and social messages. Multimedia enables new ways of communication, storage and distribution of information across the academic disciplines. In theatre studies, the majority of existing academic sources focus on the historical development of multimedia in theatrical space, as well as their practical application within experimental performance practices. In the area of theatre and set design, scholars are currently examining how technological innovations have been reflected in scenography, and consequently how they have changed the meaning of performance [1], [3], [12], [13]. Most recently, scenography has been discussed as 'experimental communication' [17, p.12], which enables the evolution of new performative spaces and their potentials [6], [19]. Furthermore, there has been an increasing interest in technology-mediated education within various fields of knowledge, including theatre studies [4], [5], [7].

The use of computer technologies for knowledge visualization and transfer has been a contentious topic across disciplines. In the light of recent changes in the accessibility and employability of powerful and now affordable technological devices, this debate has grown in importance and demands critical evaluation. So far, however, there has been little discussion about the importance of the digital reconstruction of historical artefacts, in order to deliver them interactively and creatively. Although the first generation of computer-based educational products has been developed (e.g. THEATRON project, Shakespeare Suite project, Visual Assistant), these applications have received surprisingly little scrutiny. To date, there is no consensus as to how they should be further improved for efficient use in the theatre studies classroom.

In this paper, I seek to address the question of how computer technologies can be incorporated naturally within various study-models and learning environments, focusing specifically on the study environment of Higher Education (HE) institutions.

2. DIMENSIONS OF THE COMPUTER-BASED STUDY PROCESS

The World Wide Web (WWW) acts as a major digital database that allows storing of various types of information within a structured framework and facilitates various ways of supporting study processes. It greatly enhances the flexibility in knowledge delivery and promotes learners' active participation and engagement with electronic learning materials. N. Enlund distinguishes at least four types of learning: performance learning, social interaction, collaborative learning, and individual study [9]. All these types are important in approaching new information. In this paper, however, I will concentrate on the last two, where the delivery of knowledge occurs through either solitary activity (cognitive and physical) or goal-oriented group work within computer-generated learning environments.

There is little doubt that computer-based information exchange creates an opportunity to redefine the boundaries of our social and cultural experience. It refers to real actions, people and objects, increasing the communication 'bandwidth' and enabling a smooth transition between real and virtual spaces. It occurs mainly through developing various types of interfaces for face-to-face and remote communication. As a result, learners can adjust their learning preferences and fully exploit their individual abilities for creative thinking and critical analysis. Clearly, the delivery of knowledge should be well-structured, in order to enable a consistent and systematic approach to the study materials, and it should facilitate positive attitudes towards the whole educational process. Computer-enhanced study environments provide their users with a broad range of options, choices and alternative ways of exploring relevant data interactively, but they also enable them to contribute creatively to their own learning process.

In theatre education, and specifically set design, the visual aspect of learning plays a very important role. Three dimensional (3D) perception is crucial for students' understanding of scenographic artefacts. The use of novel visualization techniques, including virtual imaging and 3D simulations, along with rich media resources, adds to users' experiences and contributes greatly to visual knowledge delivery. 3D reconstructions of historical sets - if assembled contextually and supported by extensive explanatory information - increase significantly the efficiency of the study process. This level of integration gives the learners an opportunity to interpret various destroyed or 'lost' theatre artefacts and places, in a way which was not previously possible [10].

3. THE SET-SPECTRUM PROJECT

Below, I provide a brief overview of the Set-SPECTRUM project [15]. A more detailed account, with emphasis on the project's structure and content, its integration within contemporary educational settings, and an assessment of its effectiveness, will be presented elsewhere (I. Kuksa, unpublished manuscript).

3.1 Project Overview and Structure

The Set-SPECTRUM was developed through longitudinal, cross-disciplinary research, aiming to provide a long-term pedagogical impact and satisfaction for potential user-groups. Its goal is to enable the development of the users' visual and technical literacy and research skills. The project aims bridge research and creativity in a communicable and systematic manner, in order to

enable the identification of the next stages of promoting visually-enhanced learning.

The main focus of the Set-SPECTRUM project is a pioneer of American stage design – Norman Bel Geddes (1893-1958) – and his 1921 theatrical presentation of Dante's *The Divine Comedy*. Norman Bel Geddes was involved as author and/or designer in more than two hundred plays, theatrical performances and motion pictures. He was also a talented and successful industrial designer identified with the popular 1930s streamlining style in the USA. While scholars generally agree on the historical importance of Bel Geddes' industrial designs and widely criticize his architectural projects, his impact on theatre design seems largely overlooked, or at least misjudged. Norman Bel Geddes' *The Divine Comedy* was a serious attempt to escape the obsolete two-dimensional proscenium stage, by applying the expressionistic approach to the stylization of the performance [11]. This ambitious project was intended to mark the six hundredth anniversary of Dante's death, and the author aimed to stage the play in Madison Square Garden. Bel Geddes spent approximately two years developing a fully-functional model for *The Divine Comedy* production, which, unfortunately, was lost during the last century. His original concept persist only in the form of sketches, photographs, plans, and an annotated script, which can be found in the Harry Ransom Humanities Research Centre, University of Texas at Austin.

The Set-SPECTRUM project was designed to foster learners' awareness and appreciation of the integral connection between Norman Bel Geddes and his theatrical presentation for *The Divine Comedy* and of the evolution of the twentieth century American theatre. Furthermore, it provides a new pedagogical model based on new ways of knowledge visualization that enables individual learners to attain lifelong learning skills and techniques. The Set-SPECTRUM aims to employ a new and useful vocabulary for learner-artefact interaction and creativity-training, providing greater knowledge of the use of new media technologies within the classroom and the potential to explore difficult and sensitive subjects (sightlines, shape, colour, light). The Set-SPECTRUM is envisioned ultimately as a source of knowledge, but also as a catalyst for creating new educational and design applications and customizing the teaching curriculum in the field of theatre studies.

The project consists of nine sections: Introduction, About the Project, Norman Bel Geddes, *The Divine Comedy*, 3D Reconstruction, Photo Gallery, Study Corner, Structure, and Contact. Below, I will concentrate on the 3D reconstruction of *The Divine Comedy* model, outlining the most important stages of its construction by Norman Bel Geddes and consequently of 3D modelling process.

3.2 The Set-Model Construction and Re-Construction

3.2.1 Construction

The Divine Comedy stage's general shape is a simple and economical construction, resembling the shape of a classical amphitheatre. The design for *The Divine Comedy* is full of planes, lines, and masses. The author developed several construction drawings specifically for the model (which was a twenty-fourth of full size) not the real set. The plan for it was prepared with an eight-inch scale, to be subsequently reworked to the working drawings (see Figure 1).

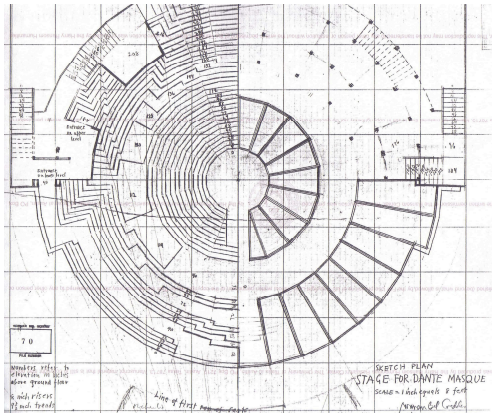


Figure 1: The working drawings of the set. Source: The HRC, the University of Texas in Austin.

The main difference between the early sketches and later elevations was the height of the upper towers, which was reduced in order to fit the whole stage inside the indoor-area of the theatre building. Bel Geddes' model of *The Divine Comedy* set pictured a circular stage, formed by numerous layers that create stepped slopes and a central pit. On the far side, the slopes were designed to ascend from the pit to a maximum height of fifty feet, if built in real life; whilst at the near side of the pit was a twelve-foot ledge, descending towards the audience seats.

The ledge formed a series of terraces, and terminated in a valley at the bottom of the pit, running half way around the circle. The valley was separated from the audience, which would have sat in a half-circle facing the orchestra, as in a Greek theatre, by a solid wall [21, pp. 148-149].

The stage-model was built with all details (see Figure 2), including means for entrance and exit, in order to be recreated rapidly in the real theatre. The real set-construction would have measured 135 feet by 165 feet. From the inside, it was supposed to be composed of swinging doors, which allowed people to pass through the whole stage or reach the top of the four towers rising from the slope in a series of stepped levels. Beneath the stage slopes Bel Geddes planned to accommodate several assembly rooms, each with a capacity of two hundred people. Each of the rooms would have been adjoined with special space for costumes and properties, and three large vibrating chambers for the magnification of sound waves. Every assembly space would also have been connected with the pit, towers and other portions of the stage by means of several passageways and stairways [11, pp. 247-253].

After the set-model was fully constructed, a professional photographer Francis Bruguière took sixty black and white pictures of the model equipped with plaster figures of the actors and correct illumination, which was arranged according to the intended plot. Although all Bel Geddes' efforts triggered more interest in *The Divine Comedy* project than anything else he had ever done, their only outcome was a published book, largely consisting of Bruguière's photographs.



Figure 2: Francis Bruguière's model photography. Source: The HRC, the University of Texas in Austin.

3.2.2 Reconstruction

The thorough analysis of the overall concept of *The Divine Comedy* enterprise together with the examination of the main technical characteristics of this production was necessary for establishing the reasons why the project has never been staged and outlining possible implications, which the staging of *The Divine Comedy* might have had for the overall flow of the performance. Indeed, *The Divine Comedy's* extraordinary stage construction, although carefully designed, represented one of the biggest challenges for contemporary theatre practitioners. Only with the emergence of 3D visualization computer technologies and advanced staging techniques can the reconstruction of this production either in cyber- or real theatrical spaces become feasible (see Figure 3). Therefore, further inconsistencies in the stage construction could have been revealed only by digitally reconstructing the set-model. The precision of Bel Geddes' drawings and plans enabled the construction of an accurate computer model, which to date, is the most exact replica of what the real stage would have looked like.

Unfortunately, the absence of the original side elevation of the stage and the lack of information on the construction of the towers, each of which, ideally, should have had a detailed explanation (i.e. plans and construction drawings) led to some difficulties during the modelling process.

Norman Bel Geddes projected the front elevation of the set from perspective drawings, as opposed to the usual development from architectural plans, which might have caused some misalignments of structures. This indicates that, although in general the original elevations are precise, there are slight inconsistencies, including the height of the front right tower, minor distortions of the shape of all four towers, and the width of the front steps of the set (see Figure 4).

Here, the white lines represent the original Bel Geddes' elevations, layered upon the 3D reconstruction. It should be noted, however, that these mistakes would not have significantly affected the overall structure of the stage and, importantly, its functionality.

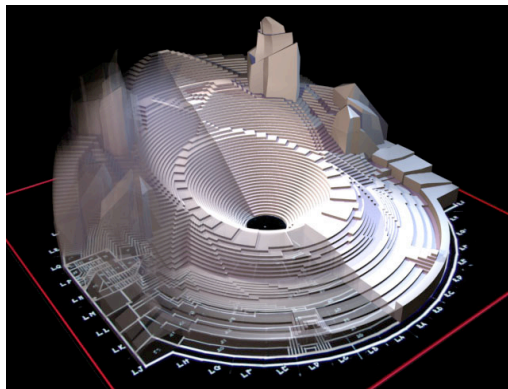
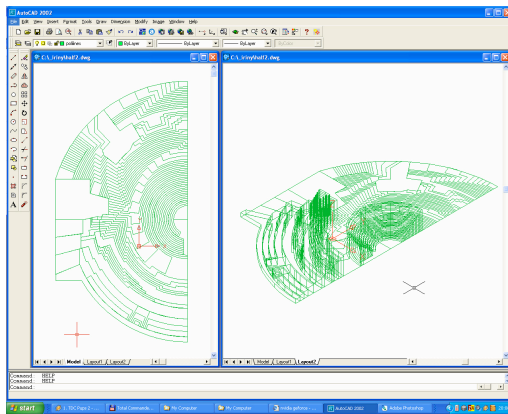


Figure 3: The process of 3D extruding in AutoCAD 2002 and 3D modelling in Discreet 3D Studio Max 7.

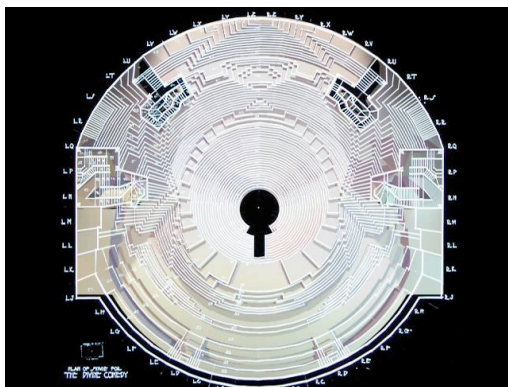


Figure 4: Inconsistencies found during the 3D modelling process.

After the digital set-model was reconstructed completely, the next step was choosing the material and texture of the construction and the setup of the stage-illumination (see Figure 5 and 6). In order to create eye-catching visual effects using the original model photography of Francis Bruguière as an example, it was decided to apply light colors and smooth texture on the set-model. Such a choice was made for ease in creating the dramatic atmosphere, by experimenting with directional and spot lights, to emphasize the uniqueness of the stage construction by generating deep shadows.

The reconstruction of the stage was based as closely to the original plans and drawings as possible. However, due to an apparent lack of side elevations and explanation of the tower's structure, some insignificant modifications in their shape might have occurred. Therefore, the students and researchers are encouraged to question the reconstruction of *The Divine Comedy* set, using the contextualization of the model with primary source materials.

4. DISCUSSION

The ongoing digital revolution could be classified as more profound than previous media transformations mainly because it affects all existing types of media simultaneously creating new ones [16]. New media technologies do not simply enhance existing cultural practices and traditional scholarship, but also challenge their very nature, encouraging new ways of interaction and knowledge delivery. These changes has a double-sided impact on contemporary educators, who might go from one extreme (i) of concentrating only on technology and its capability to enhance the quality of presentation, to another (ii) a complete ignorance of technological innovations. It can be argued that computer-generated resources and environments can enhance creativity without losing the main idea of any educational project behind technical specifications; on the other hand, technology can also be creative.

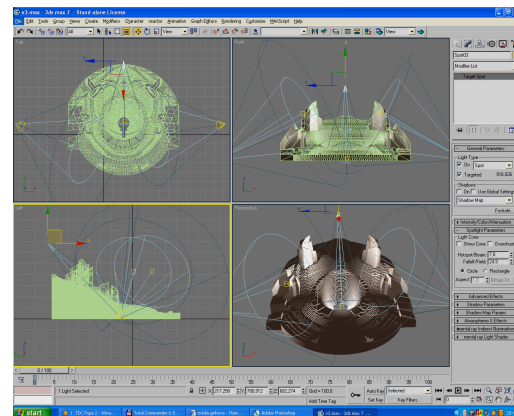


Figure 5: Positioning of the light using Discreet 3D Studio Max.

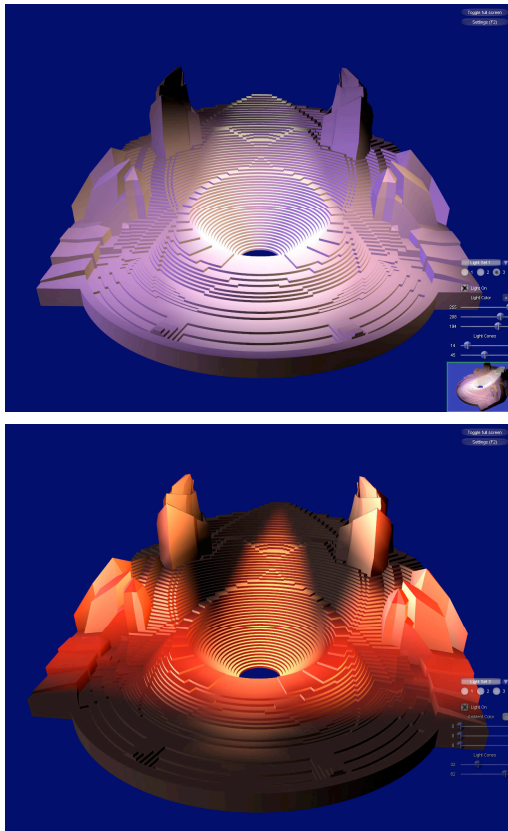


Figure 6: Creative exploration of the light using Discreet 3D Studio Max.

The integration of computation technologies into almost every aspect of our everyday lives has also led to the blurring of traditional boundaries between disciplines and discrete media. Certainly, this process has not just begun. The evolution from the *total* to the *open artwork* [8], for example, did not come as a surprise. Media and also multimedia are constantly evolving phenomena, and the artefact once translated into digital format can achieve some sort of ‘immortality’ through the vast possibilities of how it can be studied and even modified. In order to understand the full impact that multimedia has on our cultural heritage, it is necessary to be familiar with its primary elements. One of them is the international and transnational phenomenon of interactivity, which enables reciprocal exchange between viewers and artefacts, and encourages the intuitive manipulation of the medium. Others are hypermedia and narrativity [18], which caused the collapse of traditional spatial and temporal boundaries and diminished the conventional domination of a narrator, by linking various information and media in non-linear or non-sequential ways. There is little doubt that these media elements enabled new types of social relationships and knowledge delivery in contemporary society.

Theatre studies here are not an exception. This field was also influenced strongly by rapidly developing innovative means of communication. Traditionally, it combines different media elements and supports the constant connection between the audience and the stage. Unfortunately, at the moment, there is a lack of research into how new media technologies could influence the appearance of new forms of theatre. The rapid development of computation technologies makes it often difficult, and sometimes impossible, for artists to choose the appropriate technology to coincide with their visions, especially if they lack the necessary training. Here the issue of education arises. There is a shortage of educational projects, which focus particularly on computer-based information exchange and creative development. Since the late 1990s, researchers [14]; [20] noticed that e-learning amplifies, extends, and enhances learners’ cognition, and helps students to store, reshape, and analyze information. However, there were, and still are, concerns about the overall capacity of these initiatives to take root and change the established approach to education – specifically while studying scenographic artefacts. Despite this, technological innovations have already encouraged some reforms in the educational sector, including new developments for students’ learning and also teachers’ professional growth. This is happening, partly, to promote the visual element of learning, which is an integral part of theatre education and, unfortunately, often missing from existing teaching practices; and, furthermore, to support multiple learning styles, encourage self-centered learning and the personalization of knowledge delivery.

Certainly, e-learning is a relatively novel technique, and there is no doubt that any e-course or project should be structured with care, focusing the students’ attention on the study contents, rather than the technology that communicates it. At the present stage of technological awareness in the field of arts and humanities, there is a growing need to blend carefully innovative applications – such as telepresence, 3D modeling and navigation – with traditional teaching techniques, in order to avoid the potential risk of social exclusion and thus low motivation. In the theatre studies classroom there it is crucial to develop the visual skills of the students that enable them to use imagery as a creative tool and also as a means to analyze theatrical performances. This could be done most successfully by employing computer-based teaching, including 3D visualization methods, with simultaneous support of other learning activities.

Computer-based information space provides an opportunity to explore how new forms of knowledge delivery can be applied and how digitally reconstructed artefacts can be experienced in an integrated way. One might ask, however, why it is necessary to employ new means of teaching, if the old ones are still working? The answer is simple – because the tendency is that new generations of learners see the HE institution as a place with crucial resources, tools, and knowledge for research, innovation, and individualized and even lifelong learning. These demands lead to a shift towards technology-based education, which is different from technology-assisted learning in that it is not always able to provide global orientation with resources and communities. In the area of theatre history and design, the availability of visual information is particularly relevant to support the study process. Thus, when translated into digital language, scenographic artefacts become easily retrievable and highly accessible for learning and research purposes. There is little doubt that in the future, visual resources will grow in importance as primary source materials.

The Set-SPECTRUM project serves to bring this information to the learners and the key-innovations it offers, deserve to be shared as widely as possible. Changing awareness means changing standards for what is acceptable – and this happens best when people are repeatedly exposed to new ideas. There is not just one way to change awareness of new teaching techniques and their potential benefits. Such digital products should be productively promoted, not only through realization but also training because the need for communication and presenting new knowledge is critical.

Generally, it seems there is a fast-growing interest in visual knowledge transfer, including 3D modelling techniques, as more research papers and projects in this area are emerging. Nevertheless, better strategies are needed to improve the quality and comprehensiveness of digital study-resources and, in particular, to encourage their sharing. For example, the necessity of implementing novel means of delivery of various visually-driven subjects (e.g. history of scenic design) deserves researchers' attention. As learners become more computer-literate and familiar with e-learning techniques, there is a possibility that adhering to the old methods of knowledge transfer may not only cause low motivation in meaningful engagement with the study-subjects, but also negatively affect their overall perception of digital media, as representations of reality. However, such issues as the credibility and authenticity of computer-generated materials – reconstructions and simulations – must also be addressed.

5. CONCLUSION

Theatre is the art of entertainment, so why should we not make the study of it amusing too? This paper attempted to address the increasing demand for better quality visual educational resources; I presented a novel, interactive package, the Set-SPECTRUM, that enables the theoretical study of Norman Bel Geddes' creative career, working methods and theatre designs. There is no doubt that 2D renderings of *The Divine Comedy* project are very important historical artefacts. However, their major drawback is that they fail to visualize the unity of the stage, which was the main aim of the production, and it may also lack the 'wow' factor, which the author wished to create. Thus one of the main purposes of the 3D reconstruction is to contribute to the existing knowledgebase by digitally reconstructing Bel Geddes' original set-model, using the available primary sources. The intention here was to give the viewers an opportunity to appreciate fully one of the finest twentieth century modernist stage designs, by viewing its unique construction interactively in 3D. Another objective of digitally 'reviving' the production of *The Divine Comedy* was to revoke the long-lost interest of the academic community in Norman Bel Geddes' ideas and designs, filling a glaring gap in the history of theatre design.

Some findings related to this subject warrant further investigation in order to integrate Bel Geddes' contribution to the development of modern American theatre and stage design more firmly within historical, and also educational, settings. Additional empirical evaluations are needed to replicate the findings and further test the overall effectiveness of the Set-SPECTRUM in different contexts. The specific design of the Set-SPECTRUM could also be further refined in the future.

The educational approach presented in this paper requires the dissemination and adaptation of its concept, thus one of the central

tasks for the near future will be the distribution of the project and its usage by educators and researchers within different settings (e.g. HE institutions, research centers, and study suites in museums and galleries). Unquestionably, this would require substantial efforts, due to a present lack of integration between print and digital media – the academic community and the publishing industry remain wedded to the traditional print format [2]. However, nowadays, textbooks are already appearing with CDs or DVDs as a means of support, meaning that digitalization is on its way.

It could be argued that in the near future theatre scholarship is likely to turn to technologies of computation, which would require theatre scholars and creative practitioners to become much more technology confident than they are at the moment. Traditionally, they exclude themselves from the technical aspects of theatrical production, relying on technicians to accomplish their ideas. But how can you invent something new without being acquainted with the medium? Digital technologies can transform the educational techniques used in contemporary theatre studies classroom from 'ones that tell about the medium to ones that use the medium directly' [2, p. 139].

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